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# 云南西北部毛茛属一新种——文采毛茛及其核型

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# *Ranunculus wangianus* Q. E. Yang, a new species from NW Yunnan, China and its karyotype

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**Abstract** *Ranunculus wangianus* Q. E. Yang is described as new. This species, a hexaploid with $2n = 6x = 48$, is different from its closet ally, *R. yunnanensis*, a diploid with $2n = 2x = 16$, in the characters of foliage. It is also somewhat similar to *R. felixii* Lévl., but the latter is a tetraploid with $2n = 4x = 32$, usually with only one basal leaf and the roots are thickened from base and fleshy.

**Key words** *Ranunculus wangianus* Q. E. Yang; New species; Chromosome number; Karyotype

During a botanical expedition to NW Yunnan from July to September of 1998, I collected several specimens of a *Ranunculus* plant in Weixi County. At first sight this plant is very similar to *Ranunculus yunnanensis* Franch., a species fairly common in NW Yunnan and SW Sichuan. I transplanted this plant to Kunming Institute of Botany, the Chinese Academy of Sciences, to check its chromosomes. Much to my surprise, the results of chromosome examination showed that it is a hexaploid with $2n = 6x = 48$. Prior to this I had checked the chromosomes of *R. yunnanensis* based on the material from Cangshan Mountain, Dali City, NW Yunnan, and found it a diploid with $2n = 16$. Considering the great difference of the chromosome number between them, I reexamined critically the specimens I collected from Weixi and found that they are markedly different from *R. yunnanensis* in characters of foliage and thus actually represent a hitherto undescribed species. In the present paper, this new species is described, and its karyotype, together with those of *R. yunnanensis* and another possible ally, *R. felixii* Lévl., is reported.

## 1 Description of *Ranunculus wangianus* Q. E. Yang, sp. nov.

**Ranunculus wangianus** Q. E. Yang, sp. nov. Fig. 1

Haec species primo adspectu maxime similis *R. yunnanensi* Franch., qui foliis basalibus crasse papyraceis, ambitu obovato-cuneatis usque spathulatis, apice crenatis vel erosis recedit; etiam affinis *R. felixii* Lévl., qui radicibus e basi incrassatis, paullo carnosis, folio basali vulgo 1, ambitu reniformi-orbiculari usque flabellato facile distinguitur.

Herba perennis. Rhizoma breve, radices fibrosas numerosas densas haud e basi incrassatas edens. Caules 1～3, graciles, erecti, 1～3-ramosi, 10～20 cm alti, 1～4-foliati, sparse pilosi. Folia basalia vulgo ultra 3, longe petiolata; laminae papyraceae, ambitu oblato-obovatae vel obtrap-

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ezoideo-obovatae, raro suborbiculares, 1.5 ~ 3 cm longae, (1 ~ )1.5 ~ 2.5 cm latae, basi late cuneatae, apice subrotundatae, plerumque crasse 3-dentatae; petioli 5 ~ 10 cm longi, basi paullo vaginati; folia caulina inferiora foliis basalibus similia sed brevius petiolata, superiora tripartita vel integra et linearia, raro trilobata. Flores singulariter terminales, parvi, vix 1 cm diam.; receptaculum glabrum; sepala 5, extus pilosa, oblonga, circ. 3 mm longa; petala 5, lutea, obovata, circ. 4 mm longa, circ. 2.5 mm lata, apice subrotundata, basi in ungues fere 1 mm longos cuneato-angustata, foveolis nectariferis minutis; stamina numerosa, antheris oblongis, vix 1 mm longis; carpella numerosa in capitulum subsphaericum congesta. Achenia ovoideo-globosa, inflata, hirtella, stylis persistentibus, rectis vel curvatis, circ. 1 mm longis.

**China. Yunnan** (云南): Weixi (维西), Tacheng (塔城), Kena (科那), alt. 3300 m, in locis herbidis , fl. lutei, 1988-08-30, Q. E. Yang et H. Z. Kong 98207 (holotypus, PE).

Herb perennial. Rhizome short. Roots dense, numerous, not thickened. Stems 1 ~ 3, slender, erect, 10 ~ 20 cm high, 1 ~ 3-branched, 1 ~ 4-leaved, sparsely pilose. Basal leaves usually over 3 in number, long petiolate; blades papyraceous, oblate-obovate or obtrapezoid-obovate, rarely suborbicular, 1.5 ~ 3 cm long, (1 ~ ) 1.5 ~ 2.5 cm broad, base broadly cuneate, apex subrounded, very often dentate with 3 large teeth; petiole 5 ~ 10 cm long, base slightly vaginate. Lower cauline leaves similar to basal ones but with shorter petioles, upper cauline leaves tripartite or entire and linear, rarely trilobate. Flowers singularly terminal, small, less than 1 cm in diameter; receptacle glabrous; sepals 5, abaxially pilose, oblong, about 3 mm long; petals 5, yellow, obovate, about 4 mm long, about 2.5 mm broad, apex subrounded, base cuneate and narrowed into claws almost 1 mm long, nectary pit minute; stamens numerous, anthers oblong, less than 1 mm long; carpels numerous, crowed together into a subspherical head. Achenes ovoid-globose, inflated, hirtellate; styles persistent, straight or curved, about 1 mm long.

This species is most similar to *R. yunnanensis* Franch. in the habit and the characters of flower and fruit, but different in having the basal leaves papyraceous in texture, oblate-obovate or obtrapezoid-obovate in outline , rarely suborbicular, apex usually dentate with three large teeth. In *R. yunnanensis* , the basal leaves are thickly papyraceous, usually obovate-cuneate to spathulate in outline, apex crenate or erose. Another ally of this new species might be *R. felixii* Lévl., but in *R. felixii*, the roots are thickened from base and somewhat fleshy and fusiform, and there is usually only one basal leaf, which is reniform-orbicular to flabellate in outline. In chromosome number, the three species are distinctly distinguished from each other. The new species is a hexaploid with $2n = 6x = 48$, while *R. yunnanensis* a diploid with $2n = 2x = 16$ and *R. felixii* a tetraploid with $2n = 4x = 32$ (For the details of chromosomes of the three species, see below).

This species is named in honor of Professor Wang Wen-tsai (W. T. Wang), who has long been working on the taxonomy of the Chinese Ranunculaceae since the 1960s and published many taxonomic papers on this family. When I embarked on a taxonomic study of this family in the late 1980s, Professor Wang very kindly gave me a lot of warm direction and encouragement, and since then he has never stopped doing so.

## 2 Chromosomal observation on *R. yunnanensis*, *R. felixii* and *R. wangianus*

### 2.1 Materials and Methods

*R. wangianus* was collected from its type locality mentioned above, *R. yunnanensis* from an alpine meadow at an altitude of about 3400 m at Xiaohuadianba, Cangshan Mountain, Dali City, NW Yunnan and *R. felixii* from an alpine meadow at an altitude of 3600 m at Wutoudi, Yulongshan Mountain, Lijiang County, also NW Yunnan. They were cultivated in pots in the experimental

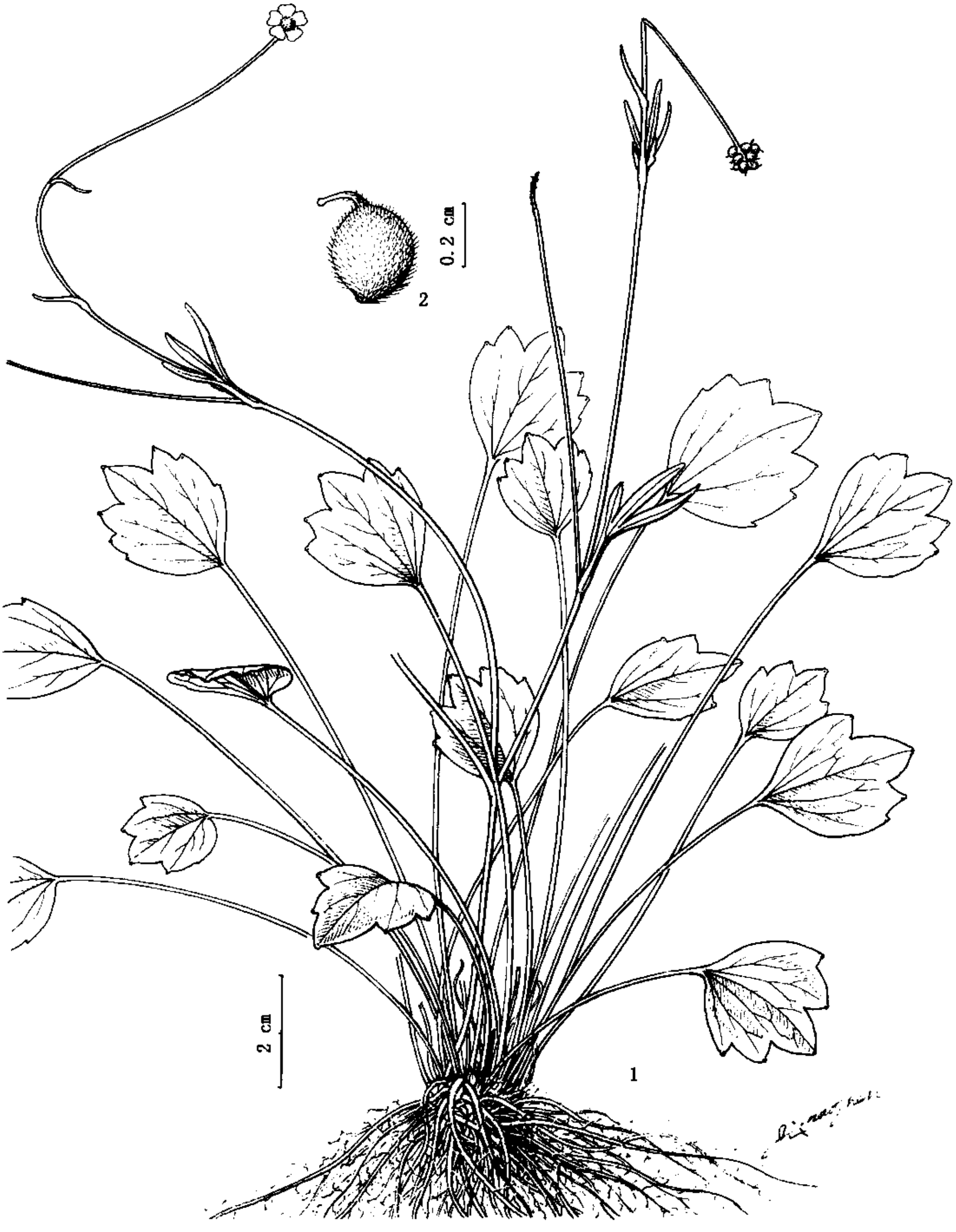

图 1 文采毛茛 1. 体态；2. 瘦果。
Fig. 1 *Ranunculus wangianus* Q. E. Yang. 1. Habit; 2. Achene.

garden of Kunming Institute of Botany, the Chinese Academy of Sciences, before their root tips were harvested for the cytological study. Actively growing root tips were pretreated in 0.1% colchicine at about 20℃ for 2.5 hr before they were fixed in Carnoy's Fixative (glacial acetic acid : absolute ethanol = 1:3) at 4℃ for 30 min, then they were macerated in 1:1 mixture of 1 mol/L hydrochloric acid and 45% acetic acid at 60℃ for 2 min, and stained and squashed in 1% aceto-orcein.

Karyotype formulas were based on the data of measurements of mitotic metaphase chromosomes. The symbols used to describe the karyotypes basically followed Levan *et al*. (1964). The karyotype classification followed Stebbins (1971).

The voucher specimen of *R. yunnanensis*, Q. E. Yang 9403 and that of *R. felixii*, Q. E. Yang 9608, were deposited in the Herbarium of Institute of Botany, the Chinese Academy of Sciences (PE).

### 2.2 Results

#### 2.2.1 *R. yunnanensis* Franch.

This species was found to be a diploid with a chromosome number of 2n = 2x = 16 (Plate Ⅰ: A). The chromosomes were moderately large, ranging from 4.5 to 2.4 μm in length from the largest to the smallest one. The total length of the chromosome complement (2n = 16) was 60.8 μm, with the average length of the chromosomes being 3.8 μm. The karyotype consisted of 8 median-centromeric (m) and 8 submedian-centromeric chromosomes (sm), with the chromosomes changing gradually from the largest to the smallest one (Plate Ⅰ: D). The karyotype was formulated as 2n = 8m + 8sm. Although the smallest chromosome pair (the 8th pair) was described as sm, the arm ratio of these two chromosomes was relatively high, reaching nearly 3.0. The ratio of the length of the largest chromosome to the smallest one was 1.8, and the proportion of chromosomes with arm ratio > 2:1 was 0.50, the karyotype was therefore of Stebbins' 2A type according to the degree of asymmetry. The chromosome number and karyotype of this species are reported here for the first time.

#### 2.2.2 *R. felixii* Lévl.

This species was found to be a tetraploid with a chromosome number of 2n = 4x = 32 (Plate Ⅰ:B). The chromosomes were moderately large, ranging from 5.3 to 2.2 μm in length from the largest to the smallest one. The total length of the chromosome complement (2n = 32) was 113.3 μm, with the average length of the chromosomes being 3.5 μm. The karyotype consisted of 10 median-centromeric and 22 submedian-centromeric chromosomes, with the chromosomes changing gradually from the largest to the smallest one (Plate Ⅰ: E). The karyotype was formulated as 2n = 10m + 22sm. The ratio of the length of the largest chromosome to the smallest one was 2.2, and the proportion of chromosomes with arm ratio > 2:1 was 0.68, the karyotype was therefore of Stebbins' 3B type according to the degree of asymmetry. Although the 32 chromosomes can be roughly allocated into 8 groups of 4 homologues, there existed obvious heteromorphy between the two chromosome pairs of the third group. The chromosome number and karyotype of this species are reported here for the first time.

#### 2.2.3 *R. wangianus* Q. E. Yang

This species was found to be a hexaploid with a chromosome number of 2n = 6x = 48 (Plate Ⅰ: C). The chromosomes were moderately large, ranging from 4.6 to 1.9 μm from the largest to the smallest one. The total length of the chromosome complement (2n = 48) was 148.9 μm, with the average length of the chromosomes being 3.1 μm. The karyotype consisted of 24 median-centromeric and 24 submedian-centromeric chromosomes, with the chromosomes changing gradually from the largest to the smallest one (Plate Ⅰ: F). The karyotype was formulated as 2n = 24m + 24sm. The ratio of the length of the largest chromosome to the smallest one was 2.7, and the proportion of chromosomes with arm ratio > 2:1 was 0.50, the karyotype was therefore of Stebbins' 2B type. It is fairly easy to allocate the 48 chromosomes into 8 groups of 6 homologues.

### 2.3 Discussion

The above results have shown that the karyotype of *R. felixii* is obviously different from that of *R. yunnanensis* and of *R. wangianus* not only in chromosome number but also in having a higher proportion of sm chromosomes in the chromosome complement. *R. yunnanensis* is a diploid, while *R. felixii* a tetraploid and *R. wangianus* a hexaploid. Among the 32 chromosomes of *R. felixii*, 22 ( about 69%) are sm, while among the 16 ones of *R. yunnanensis*, only 8 (50%) are sm and among the 48 of *R. wangianus*, only 24 (50%) are sm. It is noteworthy that *R. yunnanensis* is very similar to *R. wangianus* in chromosome morphology, though somewhat different in chromosome size.

According to a recent taxonomic revision of the genus *Ranunculus* in China (Wang, 1995), both *R. felixii* and *R. yunnanensis* belong to the ser. *Auricomi* W. T. Wang of *Ranunculus* sect. *Auricomus* (Spach) Schur. Before *R. wangianus* is described, this series includes 7 species in China, of which only *R. yunnanensis* and *R. felixii* are distributed in NW Yunnan and SW Sichuan, while the remaining 5 species are distributed in China's most northwestern region, Xinjiang, and the central Asian country Kazakhstan as well. Since *R. yunnanensis* and *R. felixii* are often overlapping in geographical distribution, it may be assumed that *R. wangianus* could have originated by hybridization and chromosome doubling from the diploid *R. yunnanensis* with $n = 8$ and the tetraploid *R. felixii* with $n = 16$ ($8 + 16 = 24$, $24 \times 2 = 48$) . From the results of karyotype analysis, however, it seems that *R. felixii* might have not been involved in the hybridization, because if it had been one of the parents, there should have been more sm chromosomes in the chromosome complement of *R. wangianus*.

From the chromosome morphology, it seems that the chromosome set of *R. wangianus* is a simple multiplication of that of *R. yunnanensis*, so the former might be supposed to be of an autopolyploid origin from the latter. Nevertheless, most of the chromosomes of *R. wangianus* are somewhat smaller than those of *R. yunnanensis* and thus it can not yet be confirmed if this inference is false or true. The GISH (genomic in situ hybridization) technique may be used to further clarify the polyploid nature and the parental origin of *R. wangianus*.

It should be pointed out that intraspecfic ploidy variation is not a rare phenomenon in the Ranunculaceae. In *Cimicifuga foetida* (Yang, 1999 b; Hasegawa, 1969), *Beesia calthifolia* (Yang, 1999 a), *Callianthemum pimpineolloides* (Yang, unpublished), *Aconitum fengii*, *A. piepunense*, *A. rockii* (Yang, 1993), *Anemone rupicola* (Baumberger, 1971), *Ranunculus cassubicus* (cf. Tamura, 1995), to mention only a few examples, two cytotypes (diplod and tetraploid ) or even more have been found, which are nevertheless gross-morphologically almost indistinguishable from each other and thus usually have not been treated as independent taxa. As to the case of *R. yunnanensis*, *R. felixii* and *R. wangianus*, however, the situation is different, for they are distinguishable from each other not only in chromosome number and chromosome size but also in gross-morphology. It seems better therefore to treat them as three independent species.

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## Explanation of plate

**Plate Ⅰ** Chromosomes of *Ranunculus yunnanensis* Franch. (A, D, 2n = 16), *R. felixii* Lévl. (B, E, 2n = 32) and *R. wangianus* Q. E. Yang (C, F, 2n = 48)

**摘要** 描述了云南西北部毛茛属一新种——文采毛茛 *R. wangianus* Q. E. Yang。该种与云南毛茛 *Ranunculus yunnanensis* Franch.十分相似,但在叶的质地和形状以及染色体数目方面明显不同。与扇叶毛茛 *R. felixii* Lévl.也相似,但后者为四倍体,须根基部肉质肥厚成纺锤形,基生叶通常1枚,叶片肾状圆形至扇形而易于区别。首次报道了云南毛茛、扇叶毛茛和文采毛茛的染色体数目和核型。

**关键词** 文采毛茛; 新种; 染色体数目;核型

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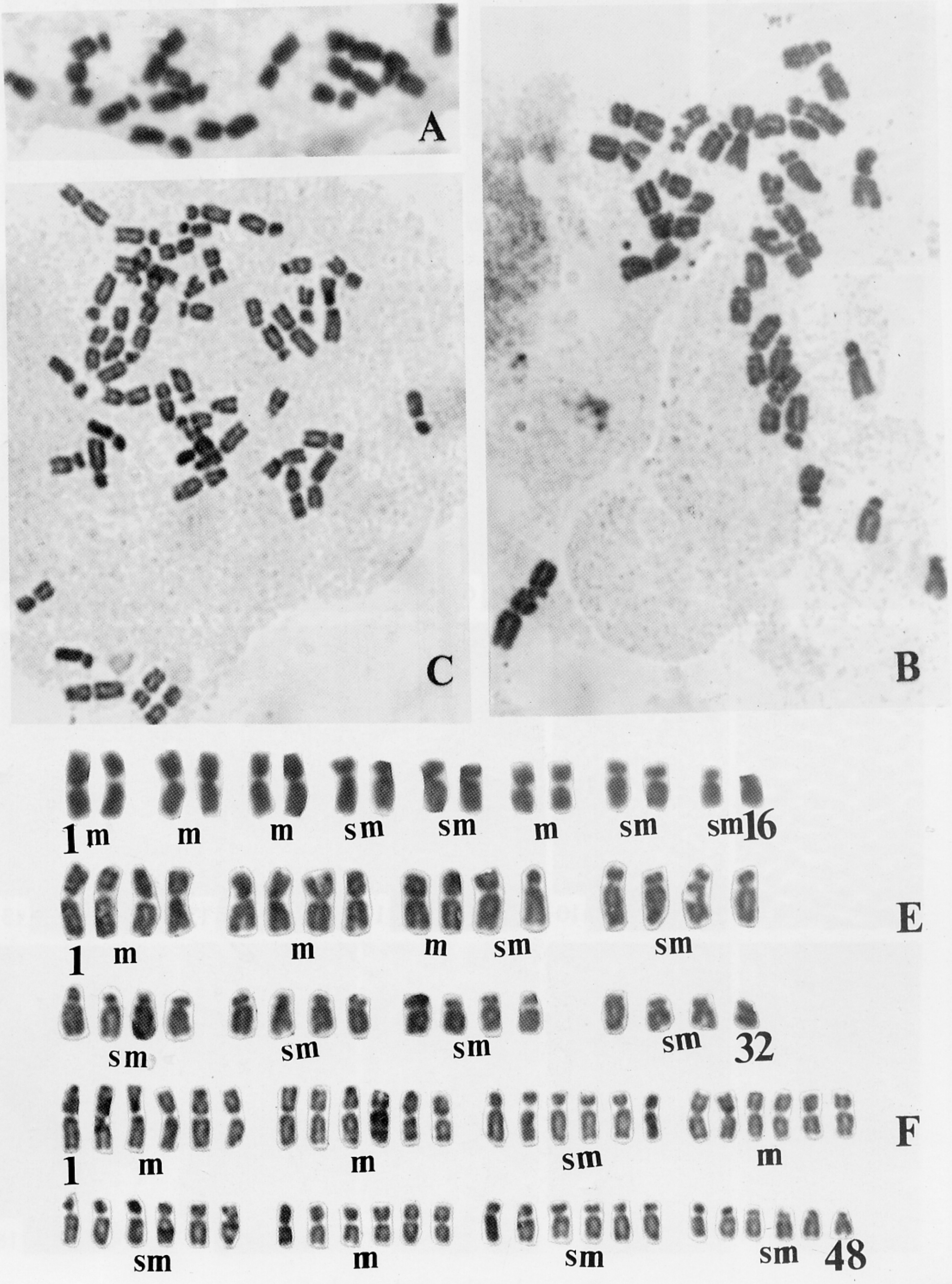
杨亲二：云南西北部毛茛属一新种——文采毛茛及其核型 图版 I

YANG Qin-Er: *Ranunculus wangianus* Q. E. Yang, a new species from NW Yunnan, China and its karyotype Plate I



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